DOCUMENT RESUME

ED 255 656 CE 041 103

AUTHOR Williamson, Bert; Pedersen, Joe F.
TITLE Performance Testing in Electronic Technology. Final Report.
INSTITUTION Skagit Valley Coll., Mount Vernon, Wash.
SPONS AGENCY Washington State Commission for Vocational Education, Olympia.
PUB DATE Dec 84
NOTE 97p.
PUB TYPE Reports - Descriptive (141) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS *Criterion Referenced Tests; Curriculum Development; Electrical Occupations; *Electric Circuits; *Electricity; Electronic Equipment; Electronics; *Electronic Technicians; Equipment Maintenance; Equipment Utilization; Job Skills; *Performance Tests; Postsecondary Education; Technical Education; *Test Construction; Two Year Colleges
IDENTIFIERS Alternating Current; Direct Current; Oscilloscopes; Soldering

ABSTRACT

This set of 21 performance tests in electronics technology was developed on the basis of a review of commercial and noncommercial instructional materials dealing with electronics technology. The tests, which were reviewed by a group of community college instructors and an advisory committee for electronics technology, address the following competencies: soldering (soldering components on a printed circuit board and unsoldering an integrated circuit); direct current tests (resistor type and value identification; resistor color codes; continuity testing; voltage, current, and resistance measurement; voltage testing for shorts and opens; operating voltmeter range multipliers; and shunting an ammeter); alternating current tests (capacitor type and value identification, RC phase angle measurement, LR phase angle measurement, series resonance characteristics, parallel resonance characteristics, bandwidth analysis, and measuring decibel gain and loss); oscilloscope tests (using an oscilloscope and measuring pulse characteristics); and circuit tests (relay control circuits, checking bipolar transistors, and designing a Zener diode regulator). Each test includes information pertaining to the purpose of the test, time limits, materials needed to administer the test, test administration procedures, and notes on grading standards. (This volume also includes a report detailing the development and validation of the tests.) (MN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

WA 413 108

ED255656

PERFORMANCE TESTING IN ELECTRONIC TECHNOLOCY

FINAL REPORT

Project No. 84-ASB(154)NB

Curriculum Development Project
Conducted Under Public Law 94-482

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.

Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Bert Williamson/Dr. Joe F. Pedersen
Skagit Valley College
2405 College Way
Mount Vernon, Washington 98273

December 1984

RESEARCH COORDINATING UNIT
Washington State Commission for Vocational Education

CE 041 163

BEST COPY AVAILABLE

FINAL REPORT

Project Number 84-ASB(154)NB

PERFORMANCE TESTING
IN
ELECTRONIC TECHNOLOGY

Curriculum Development Project
Conducted Under
Public Law 84-482

The project reported herein was performed pursuant to a grant from the Research coordinating Unit of the Washington State Commission for Vocational Education. Contractors undertaking such projects under the Commision for Vocational Education sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Commision for Vocational Education position or policy.

Bert Williamson, Project Director
Dr. Joe F. Pedersen, Principal Investigator
Skagit Valley College
2405 College Way
Mount Vernon, Washington 98273

December 1984

Table of Contents

1. Summary 1

2. Report Detail

The Problem 5

The Objective 6

Project Design & Procedures 7

Review of the Literature 8

Results and Accomplishments 10

Evaluation of the Project 12

Conclusions
Implications
Recommendations 14

3. Appendices

Appepndix 1 - Test Index 17

Appendix 2 - Performance Tests 19

Soldering Test Series 20

Direct Current Test Series 28

Alternating Current Test Series 53

Oscilloscope Test Series 76

Circuit Test Series 82

Appendix 3 - Bibliography 93

BEST COPY AVAILABLE

List of Illustrations

1. Soldering Components On A PC Board Test Unit . . . 24
2. Unsoldering An IC Test Unit 27
3. Resistor Type And Value Identification Test Unit . 30
4. Resistor Color Code Test Unit 33
5. Continuity Test Unit 36
6. Voltage, Current, Resistance Test Unit 39
7. Voltage Test for Shorts/Opens Circuit Diagram . . . 41
8. Voltage Test for Shorts/Opens Test Unit Schematic . 43
9. Voltage Test for Shorts/Opens Test Unit Photographs 44
10. Voltmeter Range Multiplier Test Unit 48
11. Shunting An Ammeter Test Unit 51
12. Capacitor ID Test Unit 55
13. RC Phase Angle Measurement Test Unit 58
14. LR Phase Angle Test Unit 61
15. Series Resonance Characteristic Test Unit 65
16. Parallel Resonance Characteristic Test Unit. 69
17. Bandwidth Analysis Test Unit 72
18. dB Measurement Test Unit 75
19. Using An Oscilloscope Test Unit 78
20. Measuring Pulse Characteristics Test Unit 81
21. Relay Control - Desired Student Diagram 84
22. Relay Control Circuit Test Unit 85
23. Bipolar Transistor Test Unit 88
24. Zener Diode Regulator Test Unit 91

SUMMARY

Time Period

This report covers curriculum development in electronic technology undertaken during the period January 1, 1984 through December 1, 1984 at Skagit Valley College in Mount Vernon, Washington.

Objectives

The general objective of the project was to develop from ten to thirty performance tests for basic electronic technology by October, 1984.

This was implemented through six sub-objectives which were:

To conduct an ERIC search for performance testing in electronic technology.

To prepare a list of performance testable skills considered important for entry level electronic technicians.

To review the list of skills with the Advisory Committee for Electronic Technology at Skagit Valley College.

To develop performance tests for selected skills from the above list.

To field test the performnce tests on appropriate electronic technology students and revise as appropriate.

To prepare a final report which includes details permitting other instructors to duplicate the performance tests developed in this project.

Procedures

An search was implemented in January 1984 for performance testing instructional materials in electronic technology. This included a library search, an ERIC search, and a review of selected commercial publications. The materials acquired through this effort were reviewed and ideas incorporated

into this project.

The investigator selected fundamental electronics as the area for focus in the initial test development phase. A list of performance testable skills was prepared by the investigator. The list was reviewed and modified by other instructors at Skagit Valley College. Twenty-one performance tests were developed from this list for inclusion in the project.

Hardware for the performance tests was constructed.

Each performance test was tested in the classroom and revisions in it made as found necessary.

The Advisory Committee for Electronic Technology reviewed the list of performance tests and the final product. They were very supportive of the project.

Results and Accomplishments

The project was implemented as outlined in the proposal. No major difficulties were encountered.

Twenty-one performance tests were developed, field tested, and placed into use in the classroom.

This project inspired a movement in the department at Skagit Valley College to expand performance testing. It also caused the staff to examine the concepts which they considered to be "essential skills" for graduates from the program. Performance testing was found to be an easy way to discuss program outcomes with advisory committee members.

Evaluation

The project has been evaluated by a variety of persons and groups. An initial evaluation was made by the writer as each test was prepared and test in the classroom. Defects in them were immediately corrected.

Faculty from the Department of Electronic Technology have reviewed the tests throughout the preparation phase. Their suggestions were incorporated.

The Advisory Committee for Electronic Technology has reviewed the completed test bank and had an opportunity to manipulte the variables in a practice test situation.

The Associate Dean for Occupational Education has reviewed the project and inspected the test units.

Finally, the principal investigator has evaluated the project in terms of meeting the objectives and time line.

The project met all objectives with the possible exception of the time line. An extension in completion time was requested in October, 1984 when it became obvious that it would be difficult to complete the classroom testing of each test. A revised completion date of December 31, 1984 was implemented at that time. The modified timeline will be met.

Conclusions and recommendations

1. Performance testing is a valuable component of student evaluation. It supplements paper and pencil testing in a unique way and provides information about the abilities of the student that would be difficult to determine through other vehicles while they are in school.

2. Performance testing requires preplanning and preparation. It is relatively time consuming. The use of specialized testing apparatus reduces the difficulty of its inclusion in the instructional setting and lends standardization and uniformity to the process.

3. Performance testing enhances instruction. When students realize that they must demonstrate their

ability to perform selected tasks individually, they change their laboratory behavior. There appears to be less tendency to let the laboratory partner make all the decisions and measurements in the course of performing laboratory experiments.

4. The project was a tremendous success and is recommended to others.

REPORT DETAIL

The Problem

Evaluation of the psychomotor skill level of electronic technology majors is an essential element in the qualification of graduates for employment in industry, yet few systematic processes are available for this purpose. Employers ask, "What can this graduate do?" Paper and pencil tests do not adequately answer this question.

Visits to most of the electronics training programs in Washington State Community Colleges during the past several years reveals that instructors usually rely on the laboratory report as the primary evaluation instrument for psychomotor skill measurement. However, the laboratory experiment has an inherent weakness when used for evaluation purposes stemming from the fact that it is usually a team effort of two persons and disguises the deficiencies of the weaker member of the team.

The most competent team member often makes decisions about the circuit configuration, assembles the circuit, and determines how tests will be performed while the weaker team member records the experimental data. Even though both students report the same experimental data in their laboratory reports, the learning which has occurred is vastly different since one student has gained a much higher mastery level by manipulating the instruments and devices in response to concepts learned previously, while the other student has fulfilled the role of observer and recorder.

This proposal attempts to address at least one aspect of the evaluation of psychomotor skill level in electronic technology students through the use of performance testing. The performance test readily reveals both strenghts and weaknesses in the student's ability to apply theoretical concepts to physical objects. These abilities and deficiencies are not usually detectable through paper and pencil testing procedures since they comprise measuring, connecting, and diagram interpretation type functions that are often required of the technician while working in the field. Once deficiencies in student performance are identified, the instructor is usually able to make changes in laboratory assignment or employ other strategies to enhance learning.

The Objective

The general objective of this project was to develop from ten to thirty performance tests for basic electronic technology by December 1984.

This was to be done through a process involving six sub-objectives. They were:

Sub-objective one

To conduct an ERIC search for performance testing in electronic technology.

Sub-objective two

To prepare a list of performance testable skills considered important for entry level electronic technicians.

Sub-objective three

To review the list of skills with the Advisory Committee for Electronic Technology at Skagit Valley College.

Sub-objective four

To develop performance tests for selected skills from the above list.

Sub-objective five To field test the performance tests on appropriate electronic technology students and revise as appropriate.

Sub-objective six To prepare a final report which includes details permitting other instructors to duplicate the performance tests developed in this project.

Project Design and Procedures

The project design utilized an initial research element implemented through an ERIC search in the hopes of discovering other performance testing efforts which could be adapted to the purposes of this project.

Subsequently, a list of performance testable skills was developed by the principal investigator and reviewed with several experts in the field. Performance tests were constructed from this list.

The performance tests were reviewed by the Advisory Committee for Electronic Technology. Their suggestions for new titles and other changes were incorporated in the final product. The performance tests were then field tested in the classroom on students enrolled in electronic technology classes at Skagit Valley College.

The principal investigator was Dr. Joe F. Pedersen. He holds a baccalaureate degree from Western Washington State University and the Masters and Doctorate Degrees in Vocational Education from the University of Kentucky. In addition, he holds a Diploma in Electronic Technology from Edison Technical School and a Certificate in the Teaching of Engineering Technology from the University of Illinois.

The student population utilized for classroom evaluation of the performance tests was composed of both preparatory and supplementary students enrolled in electronic technology at Skagit Valley College. Approximately 75 different students were involved in various groupings. This phase was conducted over a period of one year.

Review of the Literature

An ERIC search was provided by the Washington State Commission for Vocational Education. A variety of documents on performance testing in electronic technology were identified and reviewed. Selected titles are discussed below:

Chalupsky and others published a report entitled Development And Evaluation of Vocational Competency Measures (ERIC ED228474) They reported on a series of occupational competency tests which they had developed for the American Institutes for Research in the Behavioral Sciences in 1982. Included in the series was a test for electronic technicians. It was composed of three parts: 1) a series of 12 performance tests for electronic technician, 2) a job information test of the paper and pencil type, and 3. a work habits inventory of the paper and pencil type. This test has been field tested and validated.

Chalupsky noted that the major purposes for competency testing were to: 1) help teachers and administrators of secondary and post secondary vocational education programs to evaluate and improve specific areas of their vocational program and 2) to provide an objective basis for informing students, teachers, and prospective employers about progress made by students in acquiring specific job related competencies. The reliablilty and validity of the tests were also reported. They noted that results have shown the content of each test to be relevant to the job and that employees with the most experience scored highest on the test.

Shriver and Foley (ERIC ED 107698) published a document entitled Evaluating Maintenance Performance:The Development and Tryout of Criterion Referenced Job Task Performance Tests for Electrical Maintenance. They constructed model tests for equipment checkout, alignment/calibration, removal/replacement, soldering, use of test equipment, and troubleshooting. Tests were scored with either a "0" or "1" to indicate "unable to accomplish test" or "accomplished test". They profiled each student's score so that the reviewer could easily picture the degree of success achieved in the series of tests. They concluded that until maintenance, training, and personnel specialists and administrators accept and understand the fact that most paper and pencil job knowledge tests and theory tests have extremely low empirical validity, no large shift to job task

performance testing can be expected.

In 1975 Frederickson and others published "Assessment Alternatives for A High Skilled MOS. Volume I. Problem Procedures and Results. Volume II. Appendices." (ERIC ED131107). This project was sponsored for the Army Research Institute for the Behavioral and Social Sciences. They developed and protyped hands-on equipment and job sample performance tests for electronic maintenance. They concluded that valid and reliable performance tests could be constructed, but that equipment, facilities, and standardization requirements reduce the feasibility of their use at other than an ideal location such as the U. S. Army school.

A variety of texts deal with the topic of performance testing. One very fine source that was utilized by this writer was published by Erickson and Wentling. They include an excellent chapter on performance testing in their book Measuring Student Growth: Techniques and Procedures for Occupational Education. The authors note that one common misconception in the area of testing and measurement is that an individual's level of achievement with respect to some complex skill can be assessed by only focusing on the cognitive part of the individual's behavior. They suggest that the ultimate in performance measurement for occupational education is the assessment of a student's ability to perform important job-related tasks in an actual job setting.

Erickson and Wentling point out that the primary use of performance testing in occupational programs is to assess student achievement in contrast to student aptitude. In this regard, both process and product are important factors to be measured. The authors go on to discuss several instruments which provide performance measurement.

Results and Accomplishments

The ERIC search led to acquisition of one excellent document on performance testing in electronic technology which was applicable to this study. The competency test for electronic technician, which was developed by Chalupsky, Albert B., and others, was purchased through the American Association for Vocational Instructional Materials. These materials were reviewed carefully and several concepts adapted to this project.

This material was very helpful in designing a test format. Although the particular tests included in the AAVIM publication were excellent, they were not generally used in this project since they were focused on terminal qualification levels for technicians. The focus of this project was on performance testing at intermediate levels which were not necessarily terminal performance levels.

Following a review of the literature, a list of performance test topics was developed. Members of the Department of Electronic Technology at Skagit Valley College reviewed the list and made suggestions. From this list, the principal investigator selected topics for test development. Selection was based upon the topic being a fundamental electronic concept, testable in a reasonable time period at a reasonable cost, and capable of being evaluated objectively.

A format for the performance test was developed. The decision was made to prepare a test packet for each test which included the following three parts:

1. Student Instructions and Report
2. Instructions For The Examiner
3. Test Unit Construction Detail

An effort was made to limit each part to one page in length. Although this was not always achievable, it was followed in most cases.

The Student Instruction and Report page was developed so that it would be complete in itself and reproduced exactly as written. Instructions to the students and spaces for their responses were provided on it. Evaluation criteria was also specified on this page.

The Instructions For The Examiner page gives the educational objectives for the test, instructions for its administration, and standards for grading it.

The Test Unit Construction Detail page provides information useful for duplication of the apparatus used in the performance test.

Performance Tests were then written by the principal investigator using the format described above. Concurrently with this activity, performance test units were designed and prototypes constructed for each test. Most were housed in plastic construction boxes purchased from a local electronic parts store, or were constructed on printed circuit boards using standard printed circuit layup techniques.

Each performance test was then given to one or more students for an initial evaluation. Many have subsequently been tested in an actual class. Revisions have been made as need for them was identified.

All testing has been done on students enrolled in electronic technology at Skagit Valley College.

Evaluation of the Project

Evaluation by the principal investigator-

The general objective of this project was to prepare from ten to thirty performance tests for basic electronic technology by December, 1984. This was to be implemented through six sub-objectives.

The general objective and all six sub-objectives were met as outlined in the proposal.

In particular:

1. An ERIC search was made for performance testing and the results of the search incorporated into the project.

2. A list of performance testable skills was prepared.

3. The list of skills was reviewed with the Advisory Committee for Electronic Technology.

4. Performance tests were developed for selected skills on the list. A total of 21 performance tests were developed through this project.

5. The performance tests were field tested.

6. A final report was prepared and submitted on time.

Evaluation in terms of the activity/time guide-

The activity/time guide was met with the exception that an extension of one month from November to December, 1984 was requested to permit more complete classroom testing of the units. The project was completed on time on December 24, 1984.

Evaluation by staff from Occupational Administration-

The Associate Dean for Occupational Education reviewed the performance test package. Substantial support for performance testing has been received from the College administration.

Evaluation based upon field testing-

The field testing phase has been an important aspect of this project. As need for changes in the tests have become apparent, they have been made. Future users of this material will also experience need for slight modification in test specifications as each is adapted to a new situation. Most changes have been in the areas of test duration, equipment specification, and grading. The principal investigator cannot overstress the need for a dynamic and individualized implementation of grading procedures, especially for students who fail in the first attempt.

Evaluation by the Advisory Committee-

The Advisory Committee for Electronic Technology at Skagit Valley College reviewed the test package including both software and hardware. They were very supportive of the project.

Conclusions, Implications, Recommendations

1. Performance testing is a valuable component of student evaluation. It supplements paper and pencil testing in a unique way and provides information about the abilities of the student that would be difficult to determine through other techniques.

2. Performance testing requires preplanning and preparation. It is more time consuming than paper and pencil testing.

3. Performance testing enhances instruction. When students realize that they must demonstrate their ability to perform selected tasks individually, they change their laboratory behavior. There appears to be less tendency to let the laboratory partner make all the decisions and measurements in the course of performing laboratory experiments.

4. Performance tests were found to provide an excellent vehicle for communicating with members of industry on concepts considered essential in the training program.

5. Performance tests were also found to improve the communication between instructors in the electronic technology department as clarity was given to concepts considered important within the training program.

6. The use of specialized testing apparatus for performance testing enhances the inclusion of it in the instructional setting and lends standardization and uniformity to the process. The exact type of instrumentation is not a critical aspect. A variety of test instrumentation was developed during the course of this project. Several formats were found to be relatively easy to reproduce. The printed circuit board was not the most appealing aesthetically, but was easy to reproduce. Vinyl covered aluminum plates obtained through donated surplus from a local industry produced nice looking test units. Construction boxes which were purchased from a local electronic supply house were found to be very useful for instruments which involved circuitry. Although some of the test units could have been assembled by the student during a test, such an approach leads to non-standardization in test results and is time consuming for both the test administrator and the student.

7. Classroom use of performance testing appears to support the hypothesis that performance testing does identify deficiencies in certain psychomotor skills in electronic

technology students which are not evident through paper and pencil testing. During classroom testing of some of the performance tests developed in this project, the same students showing deficiencies through performance testing techniques were found to be proficient in related basic theory. No effort was made to statistically evaluate this aspect in this project.

8. The specific needs of industry for qualifications in electronic technician graduates appear to vary extensively in certain areas. Although it was initially hoped that the needs of industry could be identified as a part of this project, the principal investigator feels that such a study must be the principal effort of a future project.

9. Performance testing is highly recommended to others.

APPENDICES

APPENDIX 1

Performance Test Index

Soldering Tests

1. Soldering Components On A Printed Circuit Board
2. Unsoldering An IC

Direct Current Tests

1. Resistor Type and Value Identification
2. Resistor Color Code
3. Continuity Testing
4. E, I, & R Measurement
5. Voltage Test for Shorts and Opens
6. Voltmeter Range Multiplier
7. Shunting An Ammeter

Alternating Current Tests

1. Capacitor Type and Value Identification
2. RC Phase Angle Measurement
3. LR Phase Angle Measurement
4. Series Resonance Characteristics
5. Parallel Resonance Characteristics
6. Bandwidth Analysis
7. Measuring dB Gain/Loss

Oscilloscope Tests

1. Using An Oscilloscope
2. Measuring Pulse Characteristics

Circuit Tests

1. Relay Control Circuit
2. Checking Bipolar Transistors
3. Designing A Zener Diode Regulator

APPENDIX 2

Grading Standards:

The soldered connections are bright and shiney.

Each joint makes a good mechanical connection.

The solder is concave in shape.

Good whetting of the lead & pad are apparent.

Solder flows to the edges of each pad but not onto other pads.

There are no measled spots on the PC board.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Soldering Components On A PC Board

Purpose: To assess the student's skill in making ten consecutive good solder connections.

To determine if the student will select rosin core solder for electrical connections.

To determine if the student will clean & trim the soldered connections properly.

Time Limit: 20 minutes. Some students will use much more time if allowed. It is suggested that no credit be awarded for times exceeding 40 minutes. A penalty of .5 of the score is used if the student exceeds 20 minutes in this test.

Material:
Unstuffed printed circuit board (10 holes)
Needle nose pliers
Side cutters
25 - 40 watt soldering iron
Solder - 63/37 rosin core & 50/50 acid core
Alcohol, cotton swabs & tissue
Five 1/2 watt resistors with long leads

Procedure: Distribute instruction/report form.

Review the test requirements with the student.

Record the start time on the student's instructions and report form.

Note the student's solder selection.

Collect the test and record the time.

Stress the importance of leaving the soldering station clean and ready for the next student.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Notes on Grading Standards:

The easiest way to inspect soldered connections is with the use of a microscope or magnifier glass.

The difficulty factor in this test is increased considerably by specifying that the student is to prepare only 10 connections on a test board.

The author likes to prepare students for the test by giving many non-graded practice tests prior to the administration of a graded exam. A microscope is available for them to examine their work at all times prior to the actual test.

Opportunity for reexamination at a later date is very important in this skill area.

Pedersen 1984

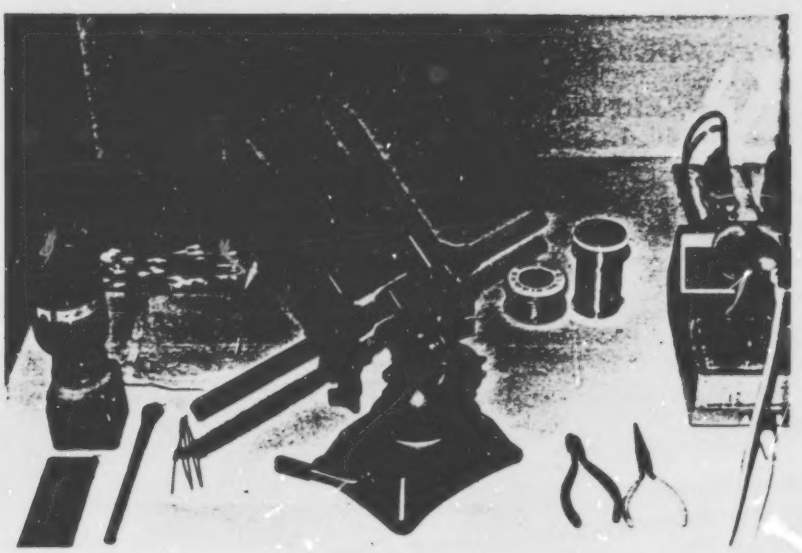
PERFORMANCE TEST-ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

Soldering Components On A PC Board

Notes: No test unit is needed for this exam. It is suggested that blank reject printed circuit boards be obtained from electronic manufacturing firms.

Photograph:



BEST COPY AVAILABLE

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++

Unsoldering An IC

Student _____ Date _____ Score _____

Skill: Unsoldering a 14 - 16 pin IC from a double sided printed circuit board without damage to the IC or PC board.

Time Limit: 15 Minutes. Start time_____ End time_____

Materials: Desoldering unit or 25-40 watt soldering iron.
Double sided printed circuit board with a 14 pin IC
Alcohol, disposable wipes
Solder wick - optional
Needle nose pliers

Notes: Check the materials on your work bench to be sure they are complete.

Steps:

1. Put your name on the test PC board.
2. Remove the integrated circuit from the printed circuit board so that neither the IC nor PC board are damaged.
3. Turn both the IC and PC board into your instructor for grading when you have finished.

Score:

Damage to the PC board?	Yes	No
Damage to the IC?	Yes	No
Good appearance of IC & PC board?	Yes	No

_____

Total number of "yes" responses.

Score = total number of "yes" X 33.3

If the time was 16 - 30 minutes multiply the score by .5; otherwise the score = 0.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Unsoldering An IC

Purpose: To assess the student's skill in unsoldering an integrated circuit from a double sided printed circuit board without damage to either the IC or PC board.

Time Limit: 15 minutes. A penalty of .5 X total score should be used for times from 16 to 30 minutes.

Material: Desoldering station - See note below
A double sided PC board with a 14 pin IC

Note: The student may perform this test using either a desoldering unit or solder wick with a low wattage soldering iron.

Procedure: Distribute the Student Instruction and Report form.

Review the test requirements with the student.

Record the start time on each student's instruction and report form. Remind the student of the time limit.

When students finish record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: Give special note to the condition of the IC and PC board. The IC should have all solder removed from the pins and show no signs of physical damage. The PC board should show no signs of overheating, be free from solder and rosin, and have no lifted lands or pads. An expert job will result in both looking new.

Pedersen 1984

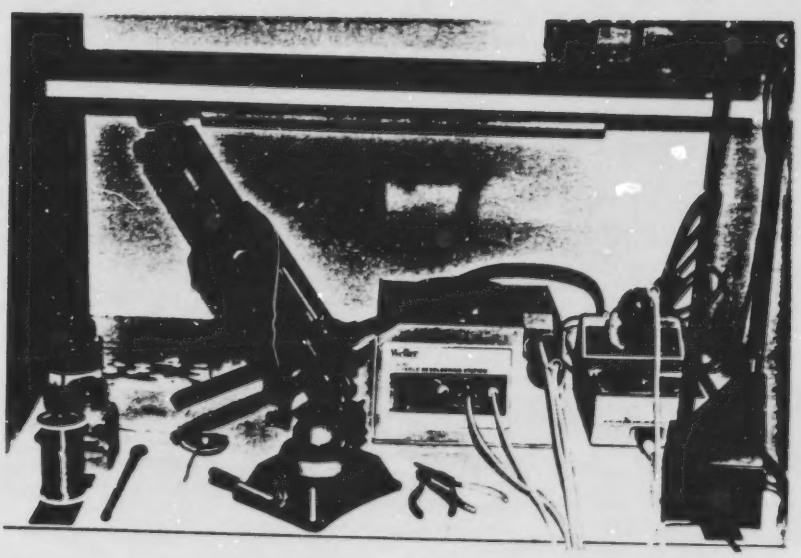
PERFORMANCE TEST-ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

Unsoldering An IC

Notes: No test unit is needed for this exam. It is suggested that a reject printed circuit with a 14 pin IC on it be obtained from an industrial source.

Photograph:



Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

++++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++++

Resistor Type and Value Identification

Student _____ Date _____ Score_____

Skill: Identifying the type and value of assorted resistors from their physical characteristics.

Time Limit: 10 Minutes. Start time_____ End time_____

Materials: Resistor Identification Unit ** Number _____
(Record Test Unit Number)

Steps: Record the following data for each resistor:

1. Value if color coded.
2. Wattage category: 1/8, 1/4, 1/2, 1, 2, over 2 watts.
3. Fixed or variable.
4. If variable, single turn or multiple turn.
5. Carbon or wire wound.

R#1 _____

R#2 _____

R#3 _____

R#4 _____

R#5 _____

Score: Score = number of resistors correctly identified X 20.

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Resistor Type and Value Identification

Purpose: To assess the student's skill in identifying resistor values from their color code.

To assess the student's skill in identifying resistor types from their physical appearance.

To assess the student's skill in identifying resistor wattages from their physical size.

Time Limit: 10 minutes. No extra time should be given for this test.

Material: Please refer to Student Instruction sheet.

Procedure: Distribute the Student Instruction and Report form and the Resistor ID Unit.

Review the test requirements with the student.

Record the start time on each student's instruction and report form.

When students finish record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: This is a beginning level test on resistors. Although tolerance may be color coded on some resistors, it is not requested. The emphasis should be focused upon the physical characteristics of the components. A correctly identified resistor cantains answers to all appropriate parts. No partial credit is awarded.

Pedersen 1984

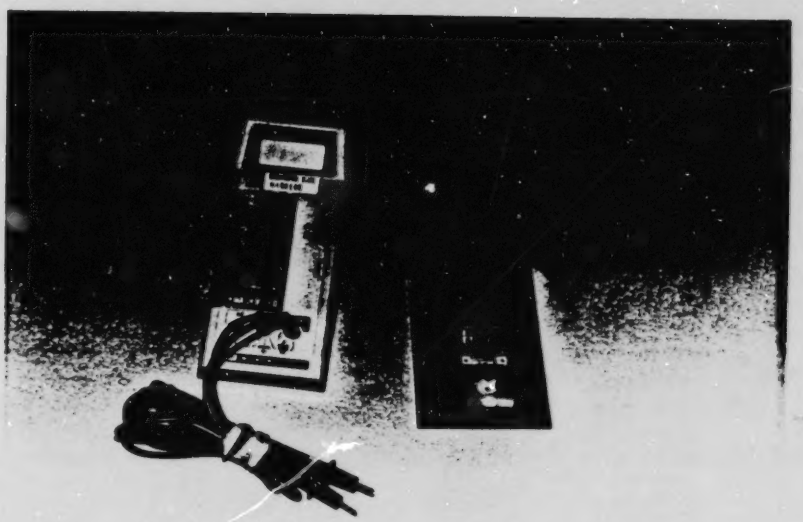
PERFORMANCE TEST—ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

Resistor Type and Value Identification

Notes: A variety of options exist for organizing the resistors used in this test. The Resistor ID Unit used by the author is a card with five resistors mounted in it. It serves only to hold the resistors and provide a means for identifying them.

Photograph:



Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

++++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++++

Resistor Color Code

Student _____ Date _____ Score_____

Skill: Reading And Measuring Resistor Values

Time Limit: 20 Minutes. Start time_____ End time_____

Materials: DMM, Calculator, Resistor Color Code Test Unit ** Record Test Unit Number _____.

Steps:

1. Read the value of each resistor on the resistor test board. Record the values in the table below.

2. Measure the resistance of each resistor with a DMM and record on the chart.

3. Determine if the resistance value falls within the tolerance range by indicating if it is good or bad.

#	CODED R OHMS	WATTAGE	MEASURED R OHMS	GOOD or BAD
1				
2				
3				
4				
5				
6				
7				
8				
9				

Score: 11 points per correctly identified resistor.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Resistor Color Code

Purpose: To assess the student's ability to identify resistor value and wattage by their color coded value and size.

To assess the student's ability to measure resistor values correctly with a DMM.

Time Limit: 20 minutes. A penalty of .5 X total score should be used for times from 21 to 40 minutes.

Materials: Resistor Test Board, DMM, & Calculator.

Comments This test verifies the student's knowledge of the resistor color code as well as their skill in using the DMM. Watch for improperly selected meter scales on the DMM giving answers to only two significant figures. Also consider the possibility of color or shade blindness in situations where the error rate is high.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit.

Caution the students to record resistor values first; then measure the resistance with the DMM. They are not to change their first answer after measuring the resistor.

As each student completes the test, record the completion time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: Credit is awarded for each resistor correctly identified (four correct answers required).

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

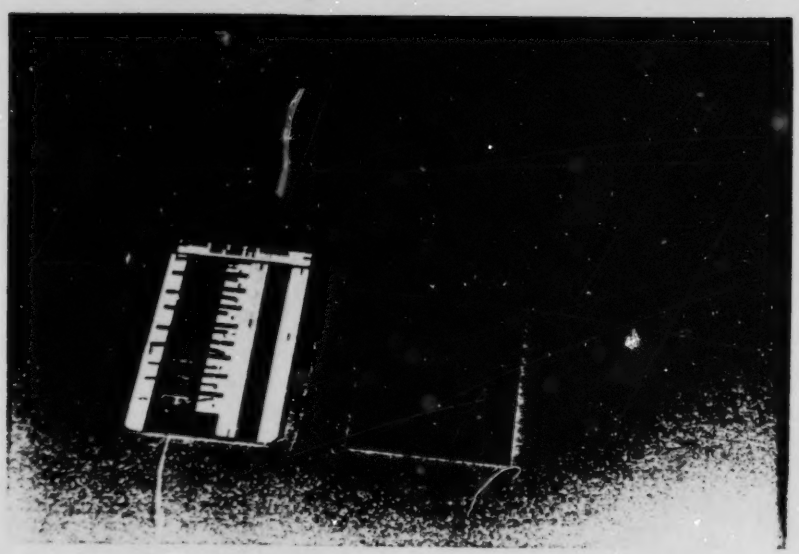
TEST UNIT CONSTRUCTION DETAIL

Resistor Color Code Test Unit

Circuit Schematic Diagram

No schematic diagram is appropriate. The author's test unit is a printed circuit board with resistors soldered to it. Please see the photograph below.

Photograph:



Pedersen 1984

PERFORMANCE TEST-ELECTRONICS

++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++

Continuity Testing

Student _____ Date _____ Score_____

Skill: Identifying short & open connections with a multimeter.

Time Limit: 10 Minutes. Start time_____ End time_____

Materials: Continuity Test Unit ** Record Number _____
Multimeter

Steps: Use the multimeter to determine answers to the following 9 questions:

1. Are the terminals shorted or open? _____
2. Are the terminals shorted or open? _____
3. Is the switch open or closed? _____
4. Which wires are shorted together? _____
5. Is the fuse shorted or open? _____
6. To which lead(s) of the switch is(are) pin 1 connected? _____
7. Is the diode open or shorted? _____
8. Are contacts 1 & 3 of the relay closed or open? _____
9. Is there a short between primary and secondary of the transformer? _____

Score: Score = number correct X 10
Multiply by .5 if over 10 minutes.

Pedersen 1984

PERFORMANCE TEST-ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Continuity Testing

Purpose: To assess the student's skill in identifying shorted and open connections in a variety of components.

Time Limit: 10 minutes. A penalty of .5 X total score should be used for times from 11 to 20 minutes.

Material: Continuity Test Unit
Multimeter (DMM ok)

Procedure: Distribute the Student Instruction and Report form and the Continuity Test Unit.

Review the test requirements with the student.

Record the start time on each student's instruction and report form.

When students finish record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: This is a basic test. The only decision that the student is asked to make is whether there is continuity between the identified points. Answers will be either yes or no. "Cannot determine" should be treated as an error.

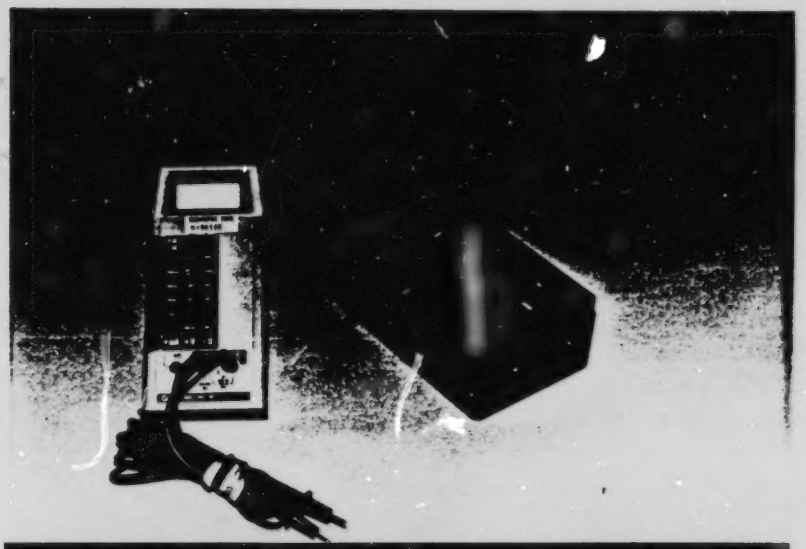
Pedersen 1984

TEST UNIT CONSTRUCTION DETAIL

Continuity Test Unit

Schematic Diagram: No schematic diagram is appropriate. The author's test unit is a box with parts mounted on it. Jacks inserted through the top to the interior provide a means of changing the shorting characteristic of all components. Please see the photograph below.

Photograph:



PERFORMANCE TEST-ELECTRONICS

++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++

E, I, & R Measurement

Student Name _____ Date _____ Score_____

Skill: Measuring voltage, current, and resistance.

Time Limit: 15 Minutes. Start time_____ End time_____

Materials: Voltage-Current-Resistance Test Unit
** Record Test Unit Number _____.
DMM or VOM

General: Do not start the exam until told to start by your instructor. Check for proper equipment.

Steps: Measure/record the resistance of R#1. _____ohms

Measure/record the current through R#1. _____amps

Measure/record the voltage across R#1. _____volts

Score:

Preset the meter correctly before connecting test leads?	Yes	No
Measured resistance correctly?	Yes	No
Measured current correctly?	Yes	No
Measured voltage correctly?	Yes	No

Total number of "yes" responses.

Score = total number of "yes" X 25
If from 16 - 30 minutes multiply score by .75; otherwise score = 0.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

E, I, & R Measurement

Purpose: To assess the student's skill in measuring voltage, current and resistance in a series circuit using a DMM

To assess the student's comprehension of the characteristics of voltage, current, and resistance.

Time Limit: 15 minutes. Students requiring more than 15 minutes should retake the test at a later time. A penalty of 25 % of score is assessed for excessive time.

Material: Please refer to Student Instruction page.

Written instructions could be substituted for the Test Unit. Use a series circuit composed of three resistors supplied with a low voltage.

Procedure: Distribute Test Unit, DMM, and instruction sheet.

Be sure the student understands what is required.

Record the start time on the student report form.

Observe the student watching for improper meter setup.

Collect the test and record the end time.

Stress importance of leaving test equipment properly stored and ready for the next student.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standard: Use of the ammeter for a voltage check will blow the fuse or trip the circuit breaker in the meter. Also watch for attempted measurement of the resistor while the power is applied. Either of these errors is an automatic failure of the test.

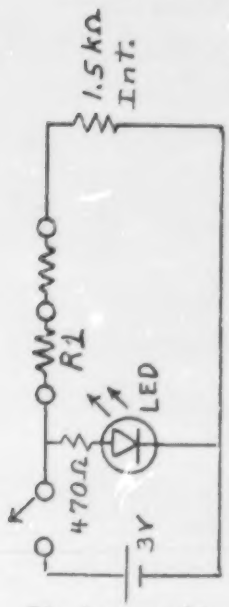
Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

Voltage-Current-Resistance Test Unit

Schematic Diagram:



Photograph:

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++

Voltage Test for Shorts & Opens

Student _____ Date _____ Score_____

Skill: Testing energized series and parallel resistive networks with a voltmeter for shorts and opens.

Time Limit: 15 Minutes. Start time_____ End time_____

Materials: Voltage Test Unit, DMM or VOM

Steps:

1. Review the schematic diagram for each circuit.

2. Test each circuit on the Test Unit with a voltmeter. DO NOT USE AN OHMMETER. Fill in each blank with one of the following codes: ASSUME ONLY ONE SHORT OR OPEN IN A CIRCUIT.

Codes For Possible Answers

O = open S = shorted CND = can not determine
OK = not open or shorted and probably good.

	Circuit 1	Circuit 2	Circuit 3
R1			
R2			
R3			
R4			
R5			
R6	XXXX	XXXX	

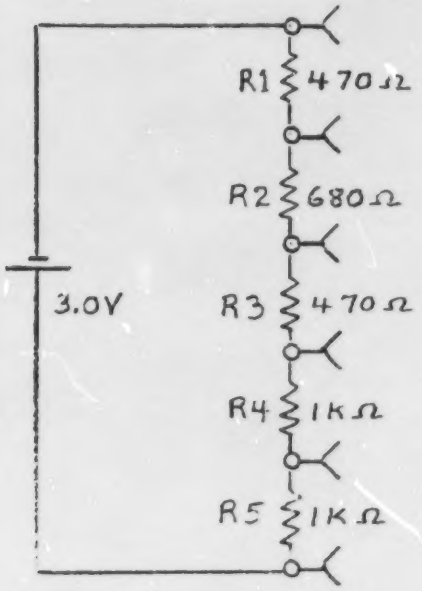
Score: Score = number of circuits correctly determined X 33.3

If the time was 16 - 30 minutes multiply the score by .5; otherwise score = 0.

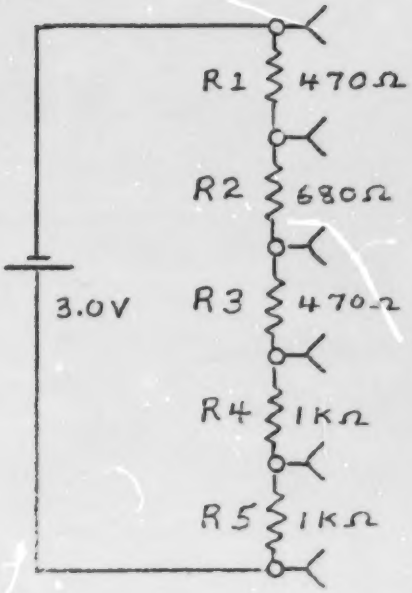
Circuit Schematic Diagrams:

Note: The batteries are located inside the test unit.

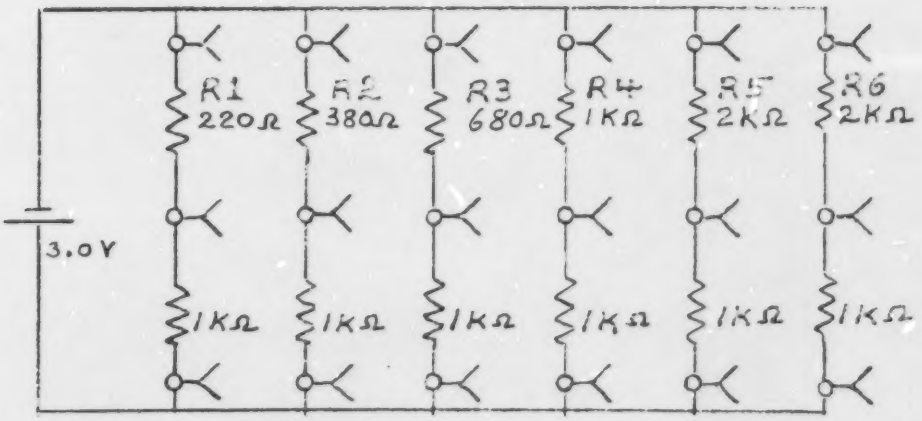
Circuit 1



Circuit 2



Circuit 3



Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Voltage Test for Shorts & Opens

Purpose: To assess the student's ability to identify shorted and open conditions in an energized resistive circuit with a voltmeter.

Time Limit: 15 minutes. A penalty of .5 X total score should be used for times from 16 to 30 minutes.

Materials: As shown on the Student Instruction page.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit. Also encourage them to use industry acceptable breadboarding techniques and note that a 10% deduction in score will be made for unacceptable work.

As each student completes the test, record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: A correct response resulting in 33 points requires correct analysis of all resistors in each circuit. No partial credit is awarded for a given circuit unless all resistors in the circuit are properly coded.

Pedersen 1984

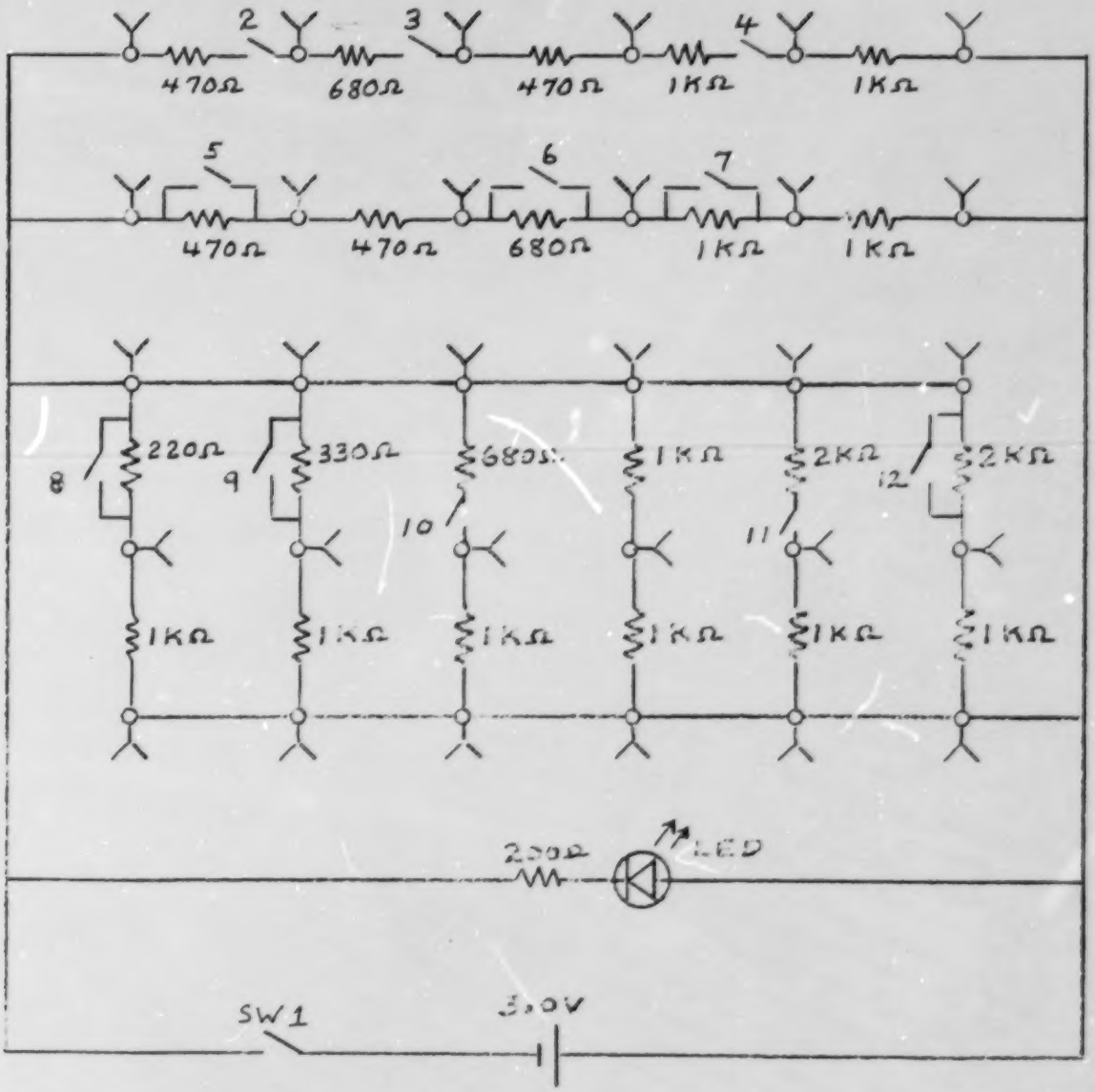
PERFORMANCE TEST—ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

Test Unit - Voltage Test for Shorts & Opens

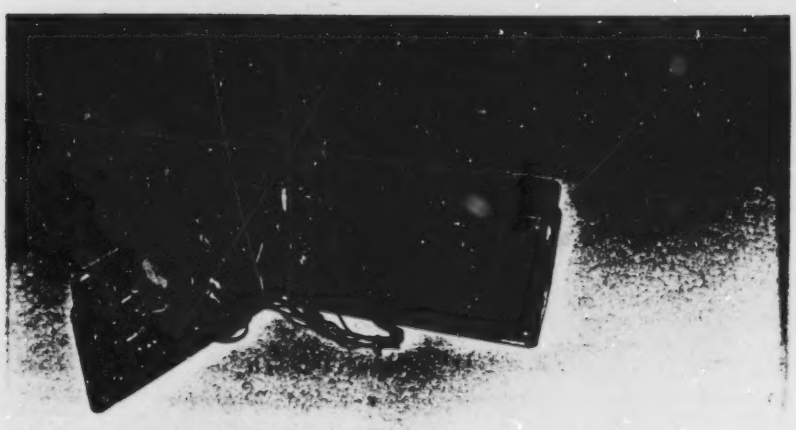
Circuit Schematic Diagram:

Note: The batteries and programming switch are located inside the unit.



BEST COPY AVAILABLE

Photographs:



Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++

Voltmeter Range Multiplier

Student _____ Date _____ Score_____

Skill: Modifying the full-scale range of a 50 uA ammeter to indicate ____ volts full-scale.

Time Limit: 20 Minutes. Start time_____ End time_____

Materials:
50 mA full-scale D'Arsonval Meter
An assortment of 1/2 watt resistors
Power Supply
DMM or other standard
Calculator

Notes: Check the materials on your work bench to be sure they are complete.

Please turn in your worksheet showing the formulas and calculations used in this test.

Steps:

1. Determine the meter characteristics: internal resistance, full scale voltage and current.

   Vm (full scale) = _____volt, Rm = _____ohms

   Im (full scale) = _____microamps.

2. Calculate the value of multiplier resistance

   Multiplier R = _____ohms

3. Install the multiplier resistor.

4. Connect the modified meter to the standard voltmeter and adjust the circuit for full-scale voltage as indicated by the modified meter.

5. Have your instructor inspect your work and complete the following statement.

   The calibration voltage was _____ V.

   The modified meter read _____.

Score:

Determined Rm, Im, & Vm correctly?	Yes	No
Calculated multiplier correctly?	Yes	No
Connected multiplier correctly?	Yes	No
Calibration within +/- 2% ?	Yes	No

Total number of "yes" responses.

Score = total number of "yes" X 25

If the modified meter was within +/- 5% multiply the score by .75; otherwise the score = 0

If 21 to 40 minutes multiply score by .50.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Voltmeter Range Multiplier

Purpose: To assess the student's skill in modifying a 50 uA ammeter so that it indicates the specified full-scale voltage.

Time Limit: 20 minutes. A penalty of .5 X total score should be used for times from 21 to 40 minutes.

Material: As specified on the Student Instruction page.

Note: Some students will use a potentiometer for a multiplier (calibration) resistance. If one of the objectives is to provide the students an opportunity to apply the concepts of equivalent resistance, they should not be allowed to use a potentiometer for the multiplier resistance and should be so notified before starting the test.

Procedure: Distribute the Student Instruction and Report form.

Review the test requirements with the student.

Record the start time on each student's instruction and report form.

When students finish record the time on their record.

Record the full-scale calibration voltage and the modified meter full-scale reading on the Student Instruction and Report sheet. Check the student's values for meter characteristics.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standard: Most students should be able to calibrate the meter to within +/- 0.5% thus, the standard of +/- 2% is generous.

PERFORMANCE TEST — ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

Voltmeter Range Multiplier

Schematic Diagram:

No special apparatus is utilized for this test. The student should be supplied with a basic ammeter movement, a box of resistors, a power supply, and a DMM to use as a standard. The student is expected to connect the proper size resistor in series with the ammeter so that it measures the specified full-scale voltage.

Photograph:

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

++++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++++

Shunting An Ammeter

Student _____ Date _____ Score_____

Skill: Modifying the full scale range of a 50 uA ammeter to a higher range.

Time Limit: 30 Minutes. Start time_____ End time_____

Materials:
50 uA full scale D'Arsonval Meter
An assortment of 1/2 watt resistors
Power Supply
DMM or other standard
Calculator

Notes: Modify the meter to measure _____ when it is at full scale.

Please turn in your worksheet showing the formulas and calculations used in this test.

Steps:

1. Determine the meter characteristics: internal resistance, full scale voltage and current.

   Vm (full scale) = _____volt, Rm = _____ohms

   Im (full scale)=_____microamps.

2. Calculate the value of shunt resistance.

   Shunt resistance = _____ohms

3. Install the shunt.

4. Connect the modified meter to the standard ammeter and adjust the circuit for full-scale current as indicated by the shunted meter.

5. Have your instructor inspect your work and complete the following statement.

   The current standard indicated _____.

Score:

Determined Rm, Im & Vm correctly?	Yes	No
Calculated shunt R value correctly?	Yes	No
Connected shunt correctly?	Yes	No
Calibration within +/- 0.2% ?	Yes	No

Total number of "yes" responses.

Score = total number of "yes" X 25

If the calibration was within +/- 5% multiply the score by .75; otherwise the score = 0

If 31 to 60 minutes multiply score by .50.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Shunting An Ammeter

Purpose: To assess the student's skill in modifying the full scale range of an ammeter.

Time Limit: 30 minutes. A penalty of .5 of total score should be used for times from 31 to 60 minutes; otherwise score = 0.

Material: See Student Instruction page.

Notify the students before the test starts whether potentiometers may be used for calibration purposes.

Select the 50 uA meter movement which is given to each student so that pretest determination of meter characteristics is impeded.

Procedure: Distribute the Student Instruction and Report form and a 50 uA meter movement.

Review the test requirements with the student.

Record the start time on each student's instruction and report form.

When students finish record the time on their record. Also record the current level indicated by the current standard. Check the student's values for meter characteristics.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standard: A +/- 2% error allowance for meter characteristics and calibration is a generous standard. Both may easily be measured directly with a high quality DMM.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

Shunting An Ammeter

Schematic Diagram: None required.

No special apparatus is utilized for this test. The student should be supplied with a basic ammeter movement, a box of resistors, a power supply and a DMM to use as a standard. The student is expected to connect the proper resistor(s) in shunt with the ammeter to produce the specified range change. Also, a current limiting resistor must be connected in series with the voltage power supply to limit its output current to the correct level.

Photograph:

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

++++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++++

Capacitor Type and Value Identification

Student _____ Date _____ Score_____

Skill: Identifying the type (and value where possible) of capacitors from physical characteristics.

Time Limit: 15 Minutes. Start time_____ End time_____

Material: Capacitor ID Test Unit ** Record Number _____

Steps: Identify the type (and value where possible) of each capacitor on the Test Unit. Record the proper code letter(s).

Code: P=paper, T=tantalum, E=electrolytic V=variable, M=mica, C=ceramic, PF=plastic film A=air, CND=Can Not Determine.

1. Type_____, Value_____, Voltage_____
2. Type_____, Value_____, Voltage_____
3. Type_____, Value_____, Voltage_____
4. Type_____, Value_____, Voltage_____
5. Type_____, Value_____, Voltage_____
6. Type_____, Value_____, Voltage_____
7. Type_____, Value_____, Voltage_____
8. Type_____, Value_____, Voltage_____
9. Type_____, Value_____, Voltage_____
10. Type_____, Value_____, Voltage_____

Score: Score = (Number correctly ID'ed caps.)(10)

If the time was 16-30 minutes multiply the score by .5; otherwise the score = 0.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Capacitor Type and Value Identification

Purpose: To assess the student's ability to identify the type of a capacitor by its physical characteristics.

To assess the student's skill in identifying the value of a capacitor by markings on its case.

Time Limit: 15 minutes. A penalty of .5 X total score should be used for times from 16 to 30 minutes.

Materials: As shown on the Student Instruction page.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit.

As each student completes the test, record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: Each capacitor must be correctly identified in order to receive credit for it. Some will have have multiple code letters ie. A, V for variable, air capacitor.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

Capacitor ID Test Unit

Circuit Schematic Diagrams: No schematic diagram is appropriate for this test unit. Ten capacitors are glued to a board. See the photograph below.

Photograph:

Pedersen 1994

PERFORMANCE TEST—ELECTRONICS

++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++

RC Phase Angle Measurement

Student _____ Date _____ Score_____

Skill: Measuring the phase angle in an RC circuit with a dual trace oscilloscope.

Time Limit: 15 Minutes. Start time_____ End time_____

Materials: Dual trace oscilloscope
Function generator (sinewave)
Series RLC Test Unit ** RECORD NUMBER ____

Steps:

1. Connect the circuit as follows: Function generator across "C" and "R#2" on the Test Unit; Channel "A" of the oscilloscope across the function generator; Channel "B" across R#2. ALL GROUNDS MUST BE CONNECTED TOGETHER!

2. Apply a 50 K Hz signal to the Test Unit. Frequency must be set very precisely.

3. Measure and record the phase shift between current and voltage in the Test Unit.

Phase shift = _____degrees.

4. Draw a phase diagram of the relationship between line current and voltage. Label the two waveforms carefully.

Score:

Is the phase shift correct?	Yes	No
Is the phase diagram correct?	Yes	No

Total number of "yes" responses.

Score = total number of "yes" X 50
If the time was 16-30 minutes multiply the score by .5; otherwise the score = 0.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

RC Phase Angle Measurement

Purpose: To assess the student's ability to measure phase angle on a dual trace oscilloscope.

To assess the student's knowledge of the technique for determining phase in a RC circuit.

Note: The phase angle can easily be changed by altering the frequency of the function generator. Students must be precise when setting the function generator frequency.

Time Limit: 15 minutes. A penalty of .5 X total score should be used for times from 16 to 30 minutes. This time limit is very generous.

Materials: As shown on the Student Instruction page.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit.

As each student completes the test, record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: Sources for errors in this test arise in the technique used for reading the oscilloscope. The author prefers adjusting the gain on both channels for a full reticule display. Likewise the horizontal display on Channel A is adjusted for a full width display. This technique provides 7.2 degree definition between horiz. graduations. Thus, the student should be able to read the phase angle within +-3.6 degrees.

Pedersen 1984

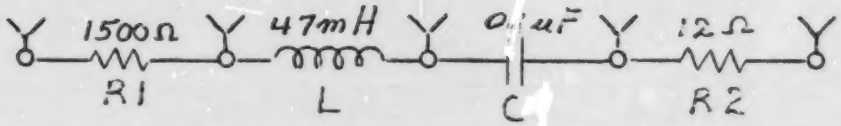
PERFORMANCE TEST-ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

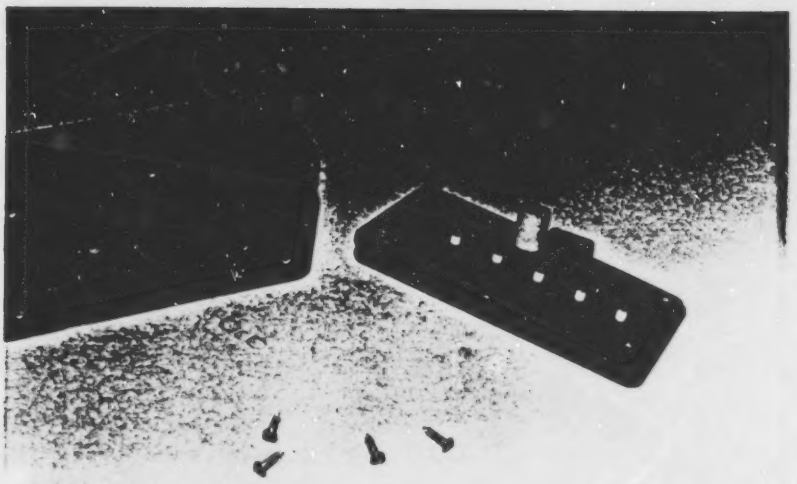
RC Phase Angle Measurement

Circuit Schematic Diagrams

This test uses the Series RLC Test Unit which is also used in other AC tests.



Photograph:



Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++

LR Phase Angle Measurement

Student _____ Date _____ Score_____

Skill: Measuring the phase angle in an LR circuit with a dual trace oscilloscope.

Time Limit: 15 Minutes. Start time_____ End time_____

Materials: Dual trace oscilloscope
Function generator (sinewave)
Series RLC Test Unit ** RECORD NUMBER ____

Steps:

1. Connect the circuit as follows: Function generator across the coil and R#1 on the Test Unit; Channel "A" of the oscilloscope across the function generator; Channel "B" across R#1. ALL GROUNDS MUST BE CONNECTED TOGETHER!

2. Apply a 4 K Hz signal to the test unit. Frequency must be set very precisely.

3. Measure and record the phase shift between current and voltage in the test unit.

Phase shift = _____degrees.

4. Draw a phase diagram of the relationship between line current and voltage. Label the two waveforms carefully.

Score:

Is the phase shift correct? Yes No

Is the phase diagram correct? Yes No

_____

Total number of "yes" responses.

Score = total number of "yes" X 50
If the time was 16-30 minutes multiply the score by .5; otherwise the score = 0.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

LR Phase Angle Measurement

Purpose: To assess the student's ability to measure phase angle on a dual trace oscilloscope.

To assess the student's knowledge of the technique for determining phase in an LR circuit.

Note: The phase angle can easily be changed by altering the frequency of the function generator. Students must be precise when setting the function generator frequency.

Time Limit: 15 minutes. A penalty of .5 X total score should be used for times from 16 to 30 minutes. This time limit is very generous.

Materials: As shown on the Student Instruction page.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit.

As each student completes the test, record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: Sources for errors in this test arise in the technique used for reading the oscilloscope. The author prefers adjusting the gain on both channels for a full reticule display. Likewise the horizontal display on Channel A is adjusted for a full width display. This technique provides 7.2 degree definition between horiz. graduations. Thus, the student should be able to read the phase angle within +-3.6 degrees.

Pedersen 1984

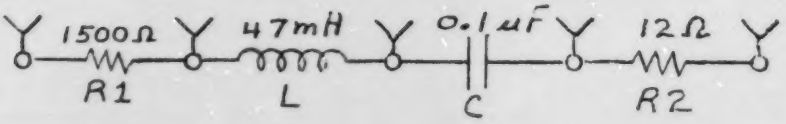
PERFORMANCE TEST—ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

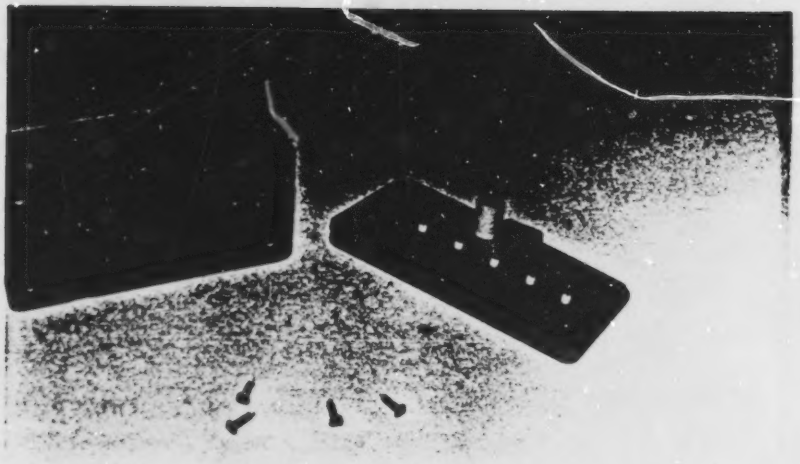
LR Phase Angle Measurement

Circuit Schematic Diagram

This test uses the RLC Test Unit which is also used in other AC tests.



Photograph:



Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++

Series Resonance Characteristics

Student _____ Date _____ Score_____

Skill: Measuring series resonant characteristics.

Time Limit: 20 Minutes. Start time_____ End time_____

Materials: Dual trace oscilloscope
Function generator (sinewave)
Series RLC Test Unit ** RECORD NUMBER _____

Steps:

1. Connect the circuit as follows: Function generator across L, C, and R2 on the Test Unit; Channel "A" of the oscilloscope across the function generator. Channel "B" of the oscilloscope across R#2 of the Test Unit. ALL GROUNDS MUST BE CONNECTED TOGETHER!

2. Measure (and record) the resonant frequency of the Test Unit with the oscilloscope.
   F(resonance) = _____Hz.

3. Measure (and record) the bandwidth of the Test Unit. BW = _____Hz.

4. Measure (and record) the Q of the Test Unit. Connections must be changed for this test
   Q = _____.

5. Draw a frequency response curve with current graphed vertical and frequency horizontal. Mark the 3dB down points on the curve. Identify their specific frequencies.

Score:

Is the resonant frequency correct?	Yes	No
Is the bandwidth correct?	Yes	No
Is the Q correct?	Yes	No
Is the graph correct and complete?	Yes	No

Total number of "yes" responses.

Score = total number of "yes" X 25
If the time was 21-40 minutes multiply the score by .5; otherwise the score = 0.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Series Resonant Characteristics

Purpose: To assess the student's ability to measure resonant frequency, bandwidth, and Q in a series resonant circuit.

To assess the student's ability to prepare a graph of the response curve for a series resonant circuit, and to identify the 3 dB down points on the curve.

Note: Although Q can be calculated after finding resonant frequency and bandwidth, the student should measure it by measuring the voltage across the capacitor and dividing it by the voltage across the resistor.

Materials: As shown on the Student Instruction page.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit.

As each student completes the test, record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: A correct graph will identify the following points: 1) resonant frequency, 2) both upper and lower frequencies at which the response is down by 3 dB.

On oscilloscopes with 8 cm vertical display, the 3 dB down points are at 2.83 cm and -2.83 cm. These should be measured within +-0.1 cm.

Pedersen 1984

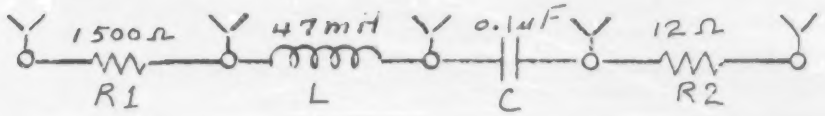
PERFORMANCE TEST-ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

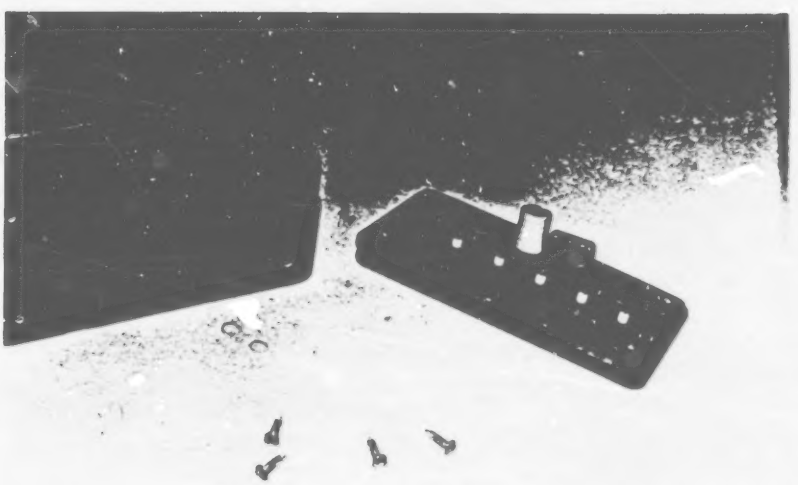
Series Resonant Characteristics

Circuit Schematic Diagram:

This test uses the series RLC Test Unit which is also used in other AC tests.



Photograph:



Pedersen 1984

BEST COPY AVAILABLE

PERFORMANCE TEST--ELECTRONICS

++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++

Parallel Resonance Characteristics

Student _____ Date _____ Score_____

Skill: Measuring parallel resonance characteristics.

Time Limit: 20 Minutes. Start time_____ End time_____

Materials: Dual trace oscilloscope
Function generator (sinewave)
Parallel RLC Test Unit ** RECORD NUMBER _____

Steps:

1. Connect the circuit as follows: Function generator across LC and R on the Test Unit; Channel "A" of the oscilloscope across the function generator. Channel "B" of the oscilloscope across LC on the Test Unit. ALL GROUNDS MUST BE CONNECTED TOGETHER!

2. Measure (and record) the resonant frequency of the Test Unit with the oscilloscope.
   F(resonance) = _____Hz.

3. Measure (and record) the bandwidth of the Test Unit. BW = _____Hz.

4. Calculate (& record) the Q of the Test Unit.
   Q = _____.

5. Draw a frequency response curve with voltage amplitude graphed vertically and frequency graphed horizontally. Identify the 3 dB down points on the curve. Mark their exact frequencies.

Score:

Is the resonant frequency correct?	Yes	No
Is the bandwidth correct?	Yes	No
Is the Q correct?	Yes	No
Is the graph correct and complete?	Yes	No

Total number of "yes" responses.

Score = total number of "yes" X 25
If the time was 21-40 minutes multiply the score by .5; otherwise the score = 0.

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Parallel Resonance Characteristics

Purpose: To assess the student's ability to measure resonant frequency and bandwidth of a parallel resonant circuit and calculate the Q of the circuit from the measured information.

To assess the student's ability to prepare a graph of the response curve for a parallel resonant circuit, and to identify the 3 dB down points on the curve.

Time Limit: 15 minutes. A penalty of .5 X total score should be used for times from 16 to 30 minutes.

Materials: As shown on the Student Instruction page.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit.

As each student completes the test, record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: A correct graph will identify the following points: 1) resonant frequency, 2) both upper and lower frequencies at which the response is down by 3 dB.

On oscilloscopes with 8 cm vertical display, the 3 dB down points are at 2.83 cm and -2.83 cm. These should be measured within +-0.1 cm.

Q should be calculated by dividing the resonant frequency by the bandwidth. It can easily be specified within +- 0.25.

Pedersen 1984

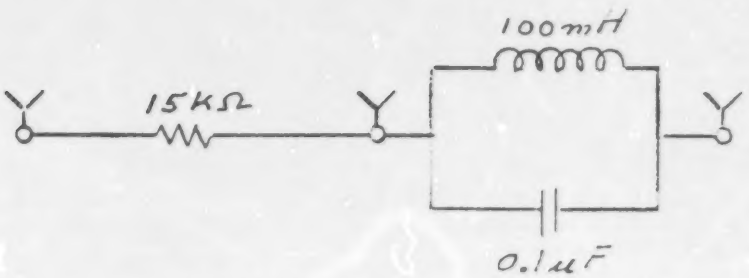
PERFORMANCE TEST-ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

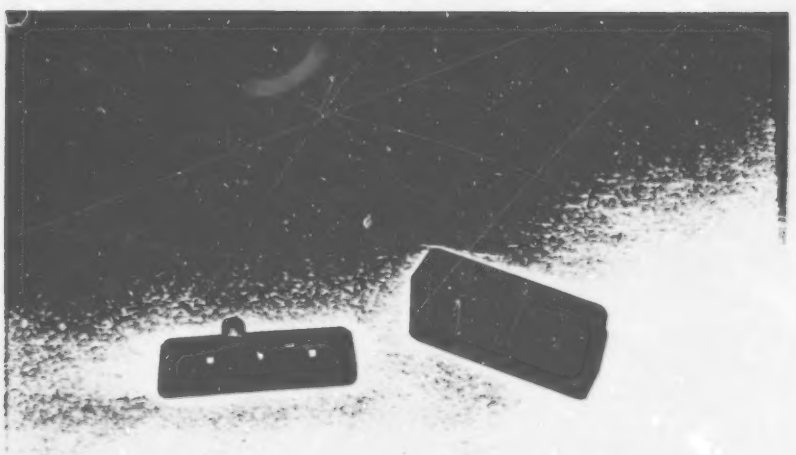
Parallel Resonance Characteristics

Circuit Schematic Diagram:

This test uses the parallel RLC Test Unit which is also used for other AC tests.



Photograph:



Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

++++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++++

Bandwidth Analysis

Student _____ Date _____ Score_____

Skill: Analyzing factors affecting bandwidth in a parallel resonant circuit.

Time Limit: 15 Minutes. Start time_____ End time_____

Materials: Bandwidth Analysis Test Unit ** Number ____
(Record Number of Analysis Unit)
Oscilloscope
DMM

Steps:

1. Measure/record the bandwidth of circuit A on the Test Unit. _____

2. Measure/record the bandwidth of circuit B on the Test Unit. _____

3. Explain why the bandwidth of the two circuits is different. Record any other measurements or calculations you make.

Score:

Is the explanation correct? Yes No

Is the explanation supported with measured data? Yes No

_____

Total number of "yes" responses.

Score = total number of "yes" X 50
If the time was 15-30 minutes multiply the score by .5; otherwise the score = 0.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Bandwidth Analysis

Purpose: To assess the student's ability to analyze the effect of inductor internal resistance upon the bandwidth of a parallel resonant circuit.

Time Limit: 15 minutes. A penalty of .5 X total score should be used for times from 16 to 30 minutes.

Materials: As shown on the Student Instruction page.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit.

As each student completes the test, record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: A correct response will conclude that the high internal resistance of the coil used in Circuit A lowers the Q of the circuit and results in a wide bandwidth.

The inductor in Circuit B has a much lower internal resistance than that of Circuit A and consequently a much narrower bandwidth.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

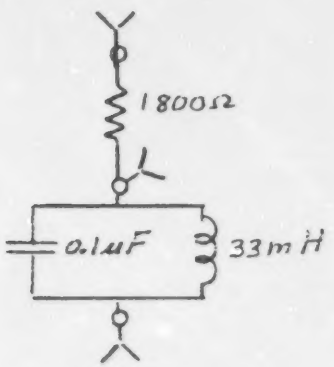
TEST UNIT CONSTRUCTION DETAIL

Bandwidth Analysis Test Unit

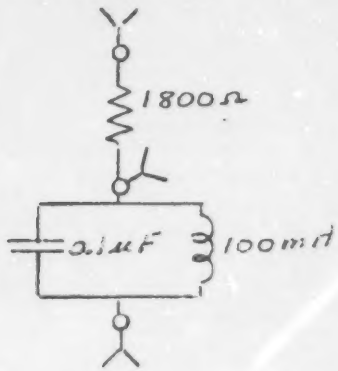
Circuit Schematic Diagrams

Inductor	Circuit A	Circuit B
L(mH)	33	100
Ri(ohms)	670	120

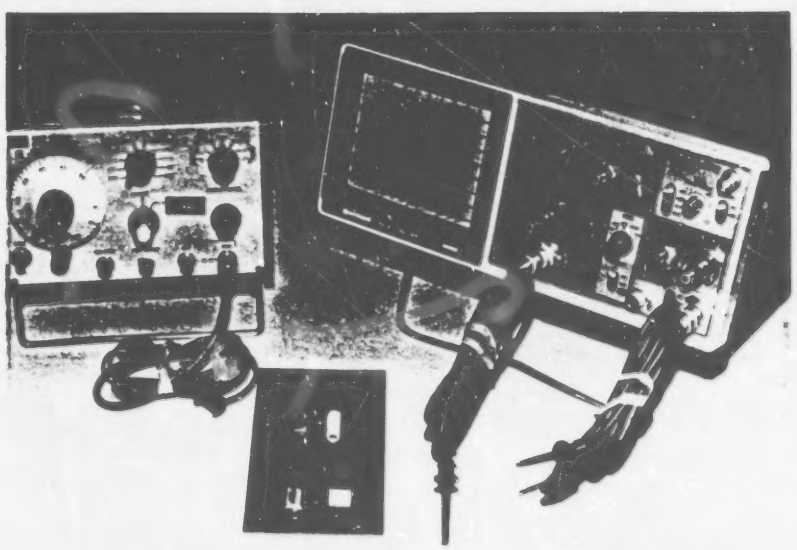
Circuit A



Circuit B



Photograph:



PERFORMANCE TEST-ELECTRONICS

++++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++++

Measuring dB Gain/Loss

Student _____ Date _____ Score_____

Skill: Determining the power gain or loss in dB in a circuit.

Time Limit: 20 Minutes. Start time_____ End time_____

Materials: dB Measurement Test Unit ** Record Number ____
Oscilloscope, DMM

Steps:

1. Measure/record the input and output impedances of the Test Unit.
   Input impedance = _____
   Output impedance = _____

2. Apply a 1,000 Hz signal to the Test Unit.

3. Measure/record the input and output signal amplitudes.
   Input signal amplitude = _____
   Output signal amplitude = _____

4. Calculate/record the gain in dB of the test Unit. dB gain = _____

5. Give the examiner the page on which calculations were made.

Score:

Is the input impedance correct?	Yes	No
Is the output impedance correct?	Yes	No
Is the gain in dB correct?	Yes	No
Was the formula correct?	Yes	No

Total number of "yes" responses.

Score = total number of "yes" X 25
If the time was 21-40 minutes multiply the score by .5; otherwise the score = 0.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Measuring dB Gain/Loss

Purpose: To assess the student's knowledge of the power gain or loss formula when measured in decibels.

To assess the student's ability to apply the dB power gain/loss formula to an actual measurement.

Time Limit: 20 minutes. A penalty of .5 X total score should be used for times from 21 to 40 minutes.

Materials: As shown on the Student Instruction page.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit. Also encourage them to use industry acceptable breadboarding techniques and note that a 10% deduction in score will be made for unacceptable work.

As each student completes the test, record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: The correct formula is:
Gain (dB) = 10 log A/B where
A = (Ein)(Ein)/(Rin) and
B = (Eout)(Eout)/(Rout)
Calculation without consideration for input and output impedances will give the wrong answer.

Pedersen 1984

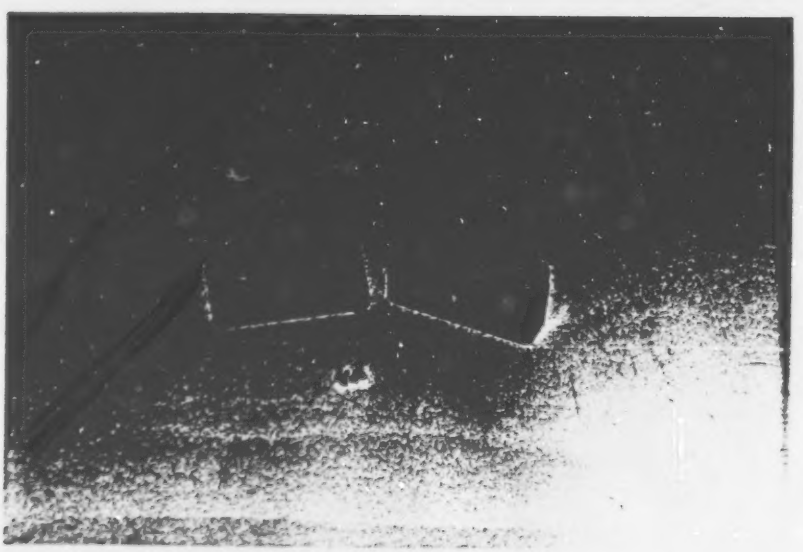
PERFORMANCE TEST—ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

dB Measurement Test Unit

Circuit Schematic Diagram:

Photograph:



Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++

Using An Oscilloscope

Student _____ Date _____ Score_____

Skill: Measuring the amplitude and period of a signal with an oscilloscope.

Time Limit: 10 Minutes. Start time_____ End time_____

Materials: Oscilloscope
Signal Source Test Unit

Steps:

1. Calibrate the oscilloscope.
2. Turn on the signal source test unit. Measure and record its output characteristics.

   Signal amplitude = _____volts

   Signal period = _____milliseconds

Score:

Is the amplitude correct?	Yes	No
Is the period correct?	Yes	No
Is the triggering correct?	Yes	No
	_____	

Total number of "yes" responses.

Score = total number of "yes" X 33.3

If from 11--20 minutes multiply score by .5

If calibration is incorrect, score = 0

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Using An Oscilloscope

Purpose: To assess the student's skill in measuring the voltage amplitude and period of a periodic waveform.

Time Limit: 10 minutes. A penalty of .5 X total score should be used for times from 11 to 20 minutes.

Materials: Oscilloscope. See note.
Signal Source Test Unit. See note.

Notes: All controls on the oscilloscope should be preset full counter-clockwise. Slide switches should be preset full left.

The student may perform this test using either a function generator which has been preset by the instructor or a Signal Source Test Unit.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Preset the oscilloscope as given above.

Record the start time on each student's instruction and report form. Remind them of the time limit.

When the students complete the test record the completion time on their records.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

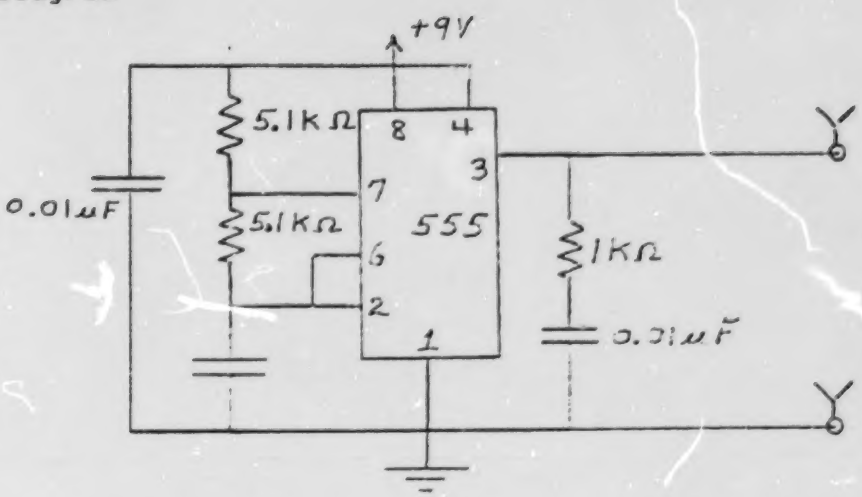
Grading Standards: Observe the waveform being displayed on the oscilloscope. It should be properly triggered and steady. Note the amplitude and period of the waveform and compare them with the student's report. An improperly calibrated oscilloscope results in a zero for the test.

Pedersen 1984

TEST UNIT CONSTRUCTION DETAIL

Signal Source Test Unit

Schematic Diagram



Photograph:

BEST COPY AVAILABLE

PERFORMANCE TEST—ELECTRONICS

++++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++++

Measuring Pulse Characteristics

Student _____ Date _____ Score_____

Skill: Measuring the characteristics of pulses with an oscilloscope.

Time Limit: 10 Minutes. Start time_____ End time_____

Materials: Signal Source Test Unit
15 MHz, singlebeam oscilloscope

Steps:

1. Calibrate the oscilloscope.

2. Connect the ground of the oscilloscope to terminal A on the Test Unit and the probe to terminal B on the Test Unit. Energize the Test Unit.

3. Measure/record the following:

   A. Amplitude _____

   B. Period _____

   C. DC offset _____

   D. Duration (on) _____

   E. Rise time _____

   F. Decay time _____

   G. Frequency (calculated)_____

Score: ((# correct) / 7)(100) = _____ points.

If the time was 11-20 minutes multiply the score by .5; otherwise the score = 0.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Measuring Pulse Characteristics

Purpose: To assess the student's ability to operate the oscilloscope at an advanced level.

To assess the student's knowledge of pulse characteristics.

Time Limit: 10 minutes. A penalty of .5 X total score should be used for times from 11 to 20 minutes.

Materials: As shown on the Student Instruction page.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit.

As each student completes the test, record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: All measurements should be within 0.5 %. This corresponds to 2 graduations in the vertical direction and 2.5 graduations in the horizontal direction.

Pedersen 1984

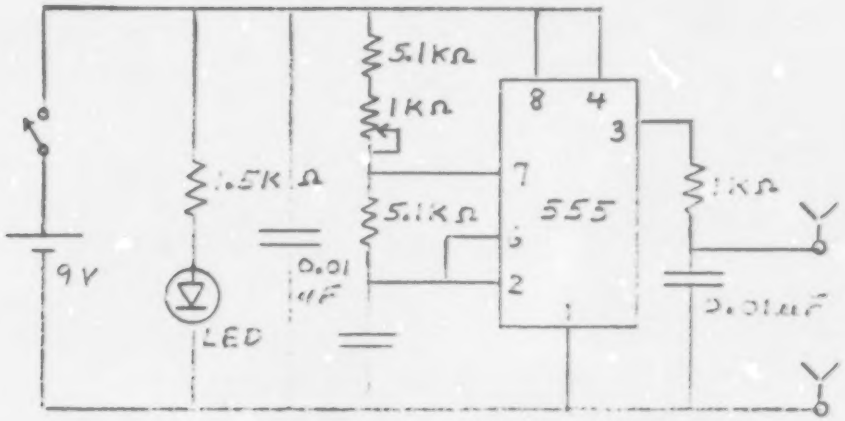
PERFORMANCE TEST-ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

Measuring Pulse Characteristics

Circuit Schematic Diagram:

Note: The battery and potentiometer shown on the diagram are located inside the test unit.



Photograph:

Pedersen 1984

BEST COPY AVAILABLE

PERFORMANCE TEST—ELECTRONICS

++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++

Relay Control Circuit

Student _____ Date _____ Score_____

Skill: Connecting a DPDT relay in a control circuit.

Time Limit: 20 Minutes. Start time_____ End time_____

Materials: Relay Test Unit ** Record Number _____.
DMM or VOM, 24 volt power supply

Steps:

1. Supply 24 volts to the Relay Test Unit. Locate the ground, +5 v., +12 v., & +24 v. sources on the Test Unit.

2. Construct a circuit with the following specifications: supply 24 v. through SW1 to the relay coil. When SW1 is open, the relay is to turn on a LED with current limiting from a 5 v. source. When SW1 is closed, the relay is to energize one #47 lamp with 5 v. and two #47 lamps connected in series with 12 volts.

2. Draw a schematic diagram of the circuit.

3. Demonstrate the circuit operation to your instructor.

4. Show your instructor your calculations for the LED circuit.

Score:

Is the 5 volt lamp circuit correct? Yes No

Is the 12 volt lamp circuit correct? Yes No

Is the LED circuit correct? Yes No

Does the circuit operate as specified? Yes No

Score = total number of "yes" X 25
If the time was 21-40 minutes multiply the score by .5; otherwise the score = 0.
If breadboarding techniques are poor, deduct 10% of the score.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Relay Control Circuit

Purpose: To assess the student's knowledge of relay wiring for control of various circuits.

Time Limit: 20 minutes. A penalty of .5 X total score should be used for times from 21 to 40 minutes.

Materials: The Relay Control Circuit Test Unit contains the following components: 1 LED, 3 #47 lamps with sockets, assorted resistors, #20 guge wire leads, and a 24 v. DPDT relay.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit. Also encourage them to use industry acceptable breadboarding techniques and note that a 10% deduction in score will be made for unacceptable work.

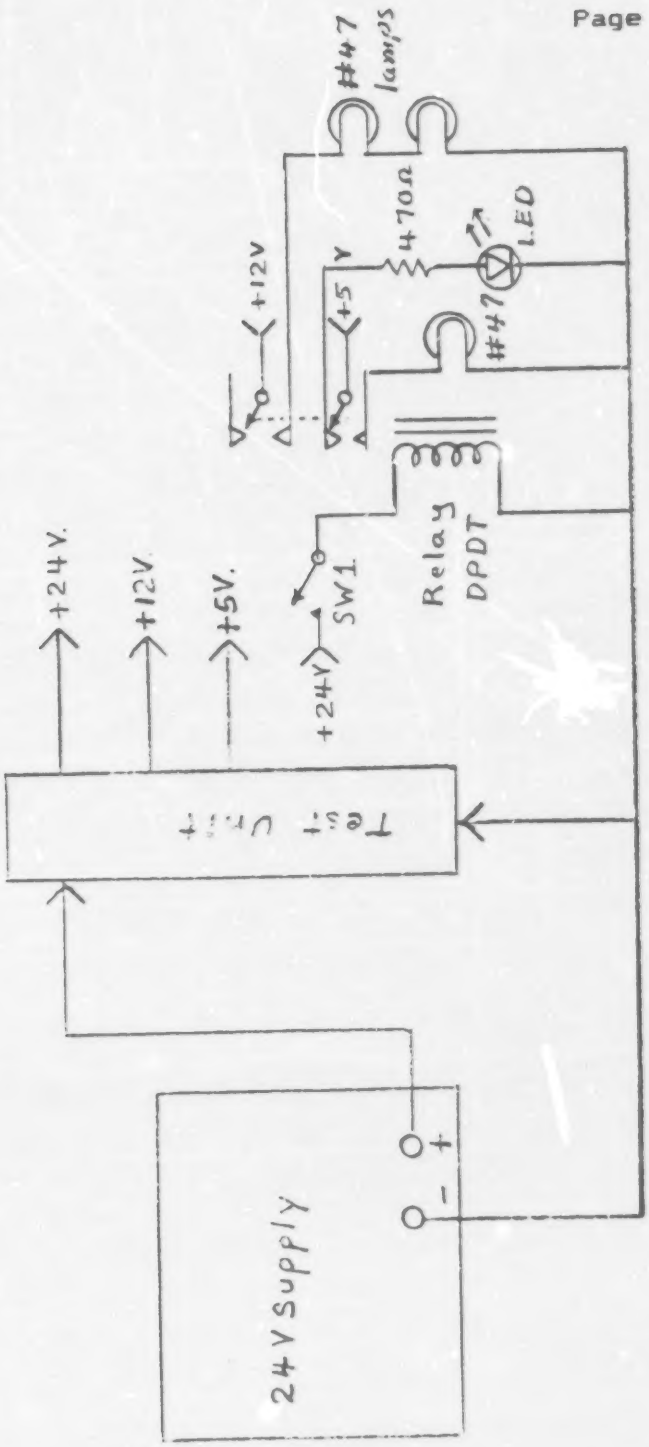
As each student completes the test, record the time on their record.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: The correct schematic diagram is given below. Note that scoring for this test awards 50 points for proper operation. Sloppy wiring techniques are to result in a 10% reduction of the total score.

Watch for correct current limiting in the LED circuit. LED current should be under 20 mA. which requires Rs to be at least 180 ohms. The maximum acceptable value for Rs is 1K ohm.

Desired Student Diagram:



Pedersen 1984

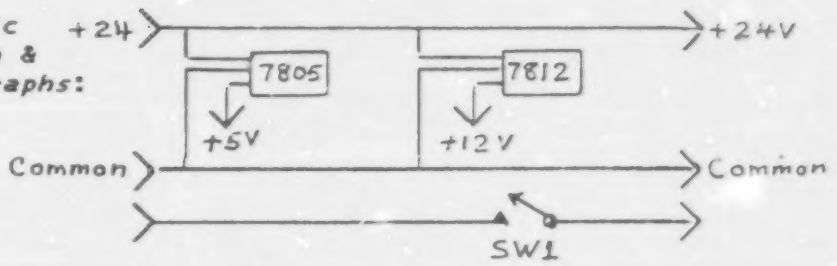
BEST COPY AVAILABLE

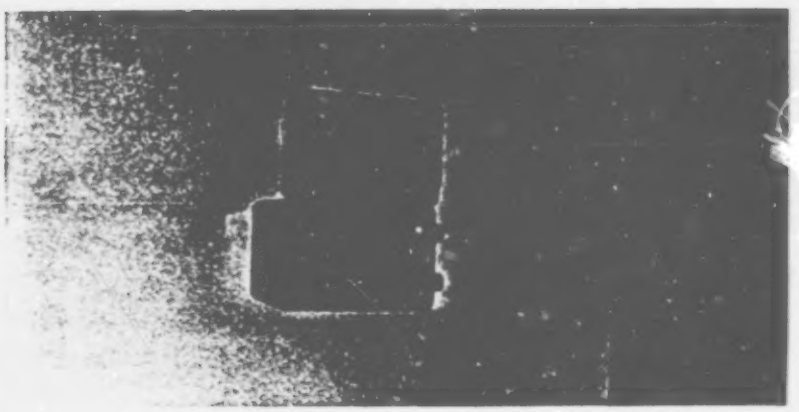
PERFORMANCE TEST-ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

Relay Control Circuit Test Unit

Schematic Diagram & Photographs:





BEST COPY AVAILABLE

PERFORMANCE TEST—ELECTRONICS

STUDENT INSTRUCTIONS AND REPORT

Checking Bipolar Transistors

Student _____ Date _____ Score_____

Skill: Checking bipolar transistors for type, shorts, opens, and base-emitter control of collector-emitter current with a DMM or VOM.

Time Limit: 20 Minutes. Start time_____ End time_____

Materials: Bipolar Transistor Test Unit
DMM or VOM

Steps: I. Measure the transistors with a DMM and record the results in the following table.

#	Type NPN? PNP? CND?	B-E Junction Shorted? Open? OK?	C-B Junction Shorted? Open? OK?	C-E Junction Shorted? Open? OK?	B-E Control of C-E Junction? Yes or No
1					
2					
3					
4					
5					

Score: Number transistors correctly tested times 20 = _____

If the time was 21-40 minutes multiply the score by .5; otherwise the score = 0.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Checking Bipolar Transistors

Purpose: To assess the student's skill in determining the type and condition of bipolar transistors with a DMM or VOM.

Time Limit: 20 minutes. A penalty of .5 X total score should be used for times from 21 to 40 minutes.

Materials: Bipolar Transistor Test Unit
DMM or VOM

Notes: "CND" in Column 2 means "Can Not Determine".

The bipolar transistor test unit specified for this test may be substituted with 5 bipolar transistors.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit.

When the students complete the test record the completion time on their records.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: This test is composed of five sub-tests for each transistor. A correct determination for any transistor requires that all five sub-tests be correct. Thus, each line on the table must be correctly completed in order to receive credit. No partial credit is to be awarded.

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

Bipolar Transistor Test Unit

Schematic Diagram: No schematic diagram is appropriate for this test. The transistors are mounted on a printed circuit board which provides easy test prod contact. Refer to the photograph below.

Photograph:

Pedersen 1984

PERFORMANCE TEST—ELECTRONICS

++++++++++++++++++++++++++++++++++++
+ *STUDENT INSTRUCTIONS AND REPORT* +
++++++++++++++++++++++++++++++++++++

Designing A Zener Diode Regulator

Student _____ Date _____ Score_____

Skill: Designing a zener diode regulator circuit for use with a variable load.

Time Limit: 20 Minutes. Start time_____ End time_____

Materials:

Designer board	Assorted resistors
DMM or VOM	10 V. Power Supply
5.1 V., 1 W. zener diode	50 ohm, 1 W. load R

Steps:

1. Construct a shunt voltage regulator circuit to reduce an unregulated 10 volt source to 5.1 volts. Use a 5.1 volt, 1 watt zener diode with a current limiting resistor. Select the value for the resistor so that the 5.1 V regulated output may be supplied to any load from infinity to 50 ohms without using unnecessary power.

2. Demonstrate the circuit operation to your instructor. Show that your calculations for power dissipation in the zener diode and current limiting resistor agree with the values used in the circuit.

Score:

Is E out 5.1 V for specified loads?	Yes	No
Is the value of limiting R correct?	Yes	No
Are calculations for power, voltage drop and current in the circuit ok?	Yes	No

_____

Total number of "yes" responses.

Score = total number of "yes" X 33.3
If the time was 21-40 minutes multiply the score by .5; otherwise the score = 0.

Score = 0 if diode destroyed.

Pedersen 1984

PERFORMANCE TEST-ELECTRONICS

****
* *INSTRUCTIONS FOR EXAMINER* *
****

Designing A Zener Diode Regulator

Purposes: To assess the student's knowledge of the operation of a zener diode regulator circuit.

To assess the student's skill in calculating the value for the current limiting resistor in a zener diode regulator circuit.

Time Limit: 20 minutes. A penalty of .5 X total score should be used for times from 21 to 40 minutes.

Materials: As shown on the Student Instruction page.

Procedure: Distribute the Student Instruction and Report form and review the test requirements.

Record the start time on each student's instruction and report form. Remind them of the time limit.

When the students complete the test record the completion time on their records.

Plan a strategy for handling students who reach a high frustration level during the test and are unable to complete it. Consider a retake later at .5 of the original point value.

Grading Standards: Acceptable output voltages are 4.9 to 5.3.

Acceptable values for the current limiting resistor are 47 to 50 ohms. Since this part dissipates 1/2 watt, a 1 watt resistor should be used in the circuit. If only 1/2 watt is used, deduct 10% from the score for poor design.

Power dissipation for the zener diode is .52 W.

The correct design is a 47 ohm, 1 watt resistor in series with the zener diode. The load is connected across the zener diode.

Pederson 1984

PERFORMANCE TEST-ELECTRONICS

TEST UNIT CONSTRUCTION DETAIL

Zener Diode Regulator Test Unit

Schematic Diagram: No circuit is given the student for this test.

Photograph:

Pedersen 1984

APPENDIX 3

BIBLIOGRAPHY

1. Chalupsky, Albert B.; And Others. Development and Evaluation of Vocational Competency Measures. Final Report. American Institute for Research in the Behavioral Sciences, Palo Alto, California, 1982.

2. Erickson, Richard C.; Wentling, Tim L. Measuring Student Growth: Techniques and Procedures for Occupational Education. Boston, Massachusetts: Allyn and Bacon, Inc., 1976.

3. Grob, Bernard. Basic Electronics. Fourth Edition. New York: McGraw Hill Book Company, 1977.

4. Frederickson, Edward W.; And Others. Assessment Alternatives for A High Skill MOS. Volume I. Problem Procedures and Results. Volume II. Appendices. Human Resources Research Organization, Alexandria, Va., 1975.

5. Mottershead, Allen. Electricity And Electronics: Electron Flow Version. New York: John Wiley & Sons, 1982.

6. Shriver, Edgar L.; Foley, John P., Jr. Evaluating Maintenance Performance: The Development and Tryout of Criterion Referenced Job Task Performance Tests for Electronic Maintenance. Final Report for Period January 1969 - May 1974. Air Force Human Resources Lab., Wright-Patterson AFB, Ohio. 1974.

7. Thompson, Charles M. Fundamentals of Electronics. New Jersey: Prentice-Hall, Inc., 1979.

8. Tocci, Ronald J. Introduction to Electric Circuit Analysis, 2nd. Edition. Ohio: Charles E. Merrill Publishing Company, 1982.

9. Zbar, Paul B. Basic Electricity: A Text-lab Manual, Fifth Edition. New York: McGraw Hill Book Company, 1983.